

**RE-COLLECTION OF *HELIANTHUS ARGOPHYLLUS*, SOURCE OF THE *Pl<sub>Arg</sub>*  
GENE FOR DOWNY MILDEW RESISTANCE, SURVIVING FOR 25 YEARS ON  
DAYTONA BEACH, FLORIDA**

GERALD J. SEILER<sup>1</sup>, TOM J. GULYA<sup>1</sup>, and LAURA FREDRICK MAREK<sup>2</sup>

<sup>1</sup>U.S. Department of Agriculture, Agricultural Research Service,  
Northern Crop Science Laboratory, 1307 18<sup>th</sup> St. N., Fargo, ND 58105.

<sup>2</sup>USDA-ARS, North Central Regional Plant Introduction Station, Iowa State University, Ames,  
IA 50011.

## **ABSTRACT**

The genus *Helianthus*, besides constituting the basic genetic stock from which cultivated sunflower originated, continues to contribute unique characteristics for cultivated sunflower improvement. Genetic diversity of the wild species has allowed the crop to become and remain economically viable by contributing genes for resistance (tolerance) to pests and environmental stresses. However, there is a continued need to collect, maintain, and evaluate wild *Helianthus* germplasm for future utilization and enhancement of cultivated sunflower. The encroachment of humans into the habitats of some wild species is an urgent concern. A population of *Helianthus argophyllus* (ARG-1575, PI 468651) was collected on Daytona Beach, Volusia County, Florida, in October, 1980. This population contained genes that were used to develop an interspecific germplasm, ARG-1575-2 (PI 539913), which was resistant to all known races of downy mildew. Since only three plants were originally found, it appeared that this population was in imminent danger of being eliminated. Surprisingly, when this location was revisited in September, 2006, 50 plants were found scattered in an abandoned beachfront lot near the original collection site. Urbanization of this area is continuing, so it is hard to predict how long this population will survive. An abundance of seeds were collected and deposited in the sunflower germplasm collection at the USDA-ARS-NCRPIS, Ames, IA.

## **Introduction**

Although sunflower originated in North America and is widely distributed across North America, some *Helianthus* species have restricted ranges. Nonetheless, since the present germplasm collection does not encompass the genetic variability of the genus *Helianthus*, additional populations of several species, particularly those that are rare, endangered, or threatened need to be collected. The human encroachment into habitats of some wild species requires special attention.

Wild sunflower species have been a valuable source of resistance genes for many of the common pathogens of cultivated sunflower. One example is downy mildew [*Plasmopara halstedii* (Farl.) Berl and de Toni], which occurs in most countries where sunflower is grown, with the apparent exception of Australia. The pathogen is unique in that it infects the seedling roots to initiate a systemic, often terminal disease, while airborne spores cause only local lesions. Until recently, fungicide seed treatments (metalaxyl and mefonoxim) were used to control

downy mildew, but the fungus has developed resistance to the chemicals. Downy mildew can be controlled by single, race-specific dominant resistance genes. Multi-race resistant germplasm and single-race resistant germplasms have been developed from crosses with wild sunflower (Miller and Gulya, 1988; Tan et al., 1992; Jan et al., 2004). Wild *Helianthus annuus* L., *H. petiolaris* Nutt., and *H. praecox* Engl. & Gray are sources of single dominant genes for single race resistance, while *H. argophyllus* T. & G. (silver leaf sunflower) is a source of a dominant gene for all known races of downy mildew (Miller and Gulya, 1988; Seiler, 1991; Miller et al., 2002; Jan and Gulya, 2006). One accession of *H. argophyllus* (ARG-1575, PI 468651) was collected on Daytona Beach, Volusia County, Florida, in October, 1980 by Gerald Seiler and Luka Cuk. Only three seven-foot-tall plants were present in the area between the sandy beach and an ocean-view home. This population gave rise to an interspecific germplasm, ARG-1575-2 (PI 539913), which was resistant to all known races of downy mildew (Seiler, 1991). Since very few seeds were collected from the original population and seed has not been available for distribution for several years, and it had been over 25 years since last visiting the original site on the very popular Daytona Beach in Florida, an exploration in September, 2006 was undertaken to revisit the site to determine if this *H. argophyllus* population had survived and if found, collect seed for the wild sunflower germplasm collection.

## Materials and Methods

The exploration to collect *H. argophyllus* from Daytona Beach, Florida, took place September 19, 2006. Mature heads were collected from approximately 20 plants and bulked into a single sample. Herbarium specimens were deposited in the USDA-ARS wild *Helianthus* herbarium at Fargo, North Dakota. The seed sample was deposited at the USDA-ARS North Central Regional Plant Introduction Station (NCRPIS), Ames, Iowa, where it is maintained and distributed.

The population collected was considered an adventive (introduced) population with its recognized distributional range being southeast coastal Texas. Population size (number and extent), habitat, soil type, seed set per head, and the presence of diseases, insects, and other wild sunflower species were recorded.

## Results and Discussion

Surprisingly, a population of the silver leaf sunflower ARG-1575 still existed at the Daytona Beach site. Figure 1 is a picture of the original few plants taken over 25 years ago at the site. The population has expanded its distribution into an abandoned lot next to oceanfront homes (Figures 2, 3, and 4). About 50 plants were scattered throughout the immediate area. There were no plants where the original three plants had been located, which was near the access road to the beach. The beach is open to vehicle traffic, but the sunflower was near the edge of the upper part of the beach near the homes. Considerable urbanization had taken place in the area, but for some reason the two oceanfront homes have survived and still provide a habitat for the wild sunflower to survive (Figures 5 and 6). How long that will continue is not known.

The distribution of *H. argophyllus* in Florida is interesting since the natural distribution is sandy soil of southeast coastal Texas. Heiser et al. (1969) stated that “this species is sometimes cultivated as an ornamental for the striking effect of the foliage.” It seems likely that the occurrence of this species in Florida as a weed today represents escapes from cultivation, although this cannot be proven. According to Heiser et al. (1969) the earliest collection from

Florida was in 1893 from “cultivated land.” They also state “that it is adventive in Florida and perhaps elsewhere.”

Heiser et al. (1969) described the Florida population as similar to the Texas populations in morphology, with slightly shorter plants, and coarser pubescence. Sister crosses of the Florida population produced yellow disk flower segregates in later generations and some are self-compatible, whereas all the Texas populations are self-incompatible.

The original population of ARG-1575 (PI 468651) contributed to an interspecific germplasm, ARG-1575-2 (PI 539913), which is resistant to all known races of downy mildew. Subsequently, this germplasm was further selected and released as inbred lines RHA 419 and RHA 420 (Miller et al., 2002). Recently, the ARG-1575-2 germplasm was shown to contain the  $Pl_{Arg}$  locus conferring resistance to at least four races (300, 700, 730, and 770) of downy mildew and was localized using simple sequence repeat (SSR) markers (Dussle et al., 2004). The  $Pl_{arg}$  gene is unlinked to other downy mildew resistance genes in sunflower. The other gene for downy mildew resistance to multiple races is  $PL_8$ , which was transferred from a *H. argophyllus* population from Texas and incorporated into inbred line RHA 340 (Miller and Gulya, 1988).

The survival of the original population of *H. argophyllus* on Daytona Beach was pleasantly surprising considering the perceived encroachment from commercialization of the area over 25 years. Predictions as to what will happen to this population in the next 25 years can only be speculation. Nevertheless, sufficient seed has been collected from the population for the USDA-ARS sunflower germplasm collection to preserve it for future use. Seed from the re-collection of *H. argophyllus* accession, PI 468651, can be requested by contacting <http://www.ars-grin.gov>.

## References

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Figure 1. Plant from the original *H. argophyllus* population (ARG-1575) collected October, 1980, on Daytona Beach, Florida.





Figure 2. A cluster of *Helianthus argophyllus* plants on September 19, 2006 near the beach of Daytona Beach with the Atlantic Ocean in the background.



Figure 3. A close-up picture of the “silver leaf” sunflower showing the dense pubescence on the leaves, stems, and heads.





Figure 4. Flowering plants of *H. argophyllus* thriving in a vacant lot next to an oceanfront home on Daytona Beach with the Atlantic Ocean in the background.



Figure 5. Daytona Beach looking north from the collection site showing the commercialization of the beach area.





Figure 6. Arrow near the shrubs on the upper right part of the beach indicates where *H. argophyllus* was found behind the shrubbery. Also note the intense commercialization of the nearby areas.